PI 1084206

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**APPLICATION NUMBER:** *60/486,205*
**FILING DATE:** *July 08, 2003*
**RELATED PCT APPLICATION NUMBER:** *PCT/US03/22893*

**By Authority of the**
**COMMISSIONER OF PATENTS AND TRADEMARKS**

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| Docket Number: | P26,788USA |
|---|---|

# PROVISIONAL APPLICATION FOR PATENT COVER SHEET (Small Entity)

**This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).**

19587 U.S. PTO
60/486205

| INVENTOR(S)/APPLICANT(S) | | |
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☒ *Additional inventors are being named on page 2 attached hereto*

**TITLE OF THE INVENTION (280 characters max)**

~~STRUCTURAL PLASTIC I BEAMS~~ Nested and Flanged Degradation-Resistant Building Forms

**CORRESPONDENCE ADDRESS**

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**ENCLOSED APPLICATION PARTS *(check all that apply)***

| | | | | | |
|---|---|---|---|---|---|
| ☒ Specification | *Number of Pages* | 9 | ☐ Small Entity Statement | | |
| ☒ Drawing(s) | *Number of Sheets* | 6 | ☒ Other (specify) | Acknowledgment Post Card | |

**METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT *(check one)***

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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

*Respectfully submitted,*

SIGNATURE [signature] Date July 8, 2003

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Date of Deposit: July 8, 2003

Title: ~~STRUCTURAL PLASTIC I-BEAMS~~ Nested and Flanged Degradation-Resistant Building Forms

**Inventors:** Thomas J. Nosker, Richard W. Renfree and James Kerstein

Type of Documents:

1. Provisional Application Cover Sheet (Small Entity) (x2) – 1 page
2. Provisional Patent Application - 9 pages
3. Drawing – 6 sheets
4. Acknowledgement Post Card
5. Express Mail Certificate

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| Docket Number: | P26,788USA |
|---|---|

# PROVISIONAL APPLICATION FOR PATENT COVER SHEET (Small Entity)

| INVENTOR(S)/APPLICANT(S) | | |
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# NESTED AND FLANGED DEGRADATION-RESISTANT BUILDING FORMS

## FIELD OF THE INVENTION

[0001] This invention pertains to new building forms made of degradation-resistant composites; structures produced from such novel forms; and related methods of producing and using such forms and structures.

## BACKGROUND OF THE INVENTION

[0002] Building forms made from wood, such as wooden I-beams, are widely used in construction throughout North America. Indeed, it is estimated that there presently are over 500,000 wooden vehicular bridges in the United States. Wood construction forms are subject to natural degradation, reducing the effective lifetime of such structures. Moreover, the flange sections of wooden construction forms, such as I-beams, can be subject to structural failure, requiring reinforcement of the flange area with synthetic fibers or other materials. Common chemicals used in the preservative treatment of such wood building forms have been found harmful to the environment. Due to the lack of suitable replacement materials and cost associated with stronger "nondegradable" materials such as steel, wood building forms continue to be widely used despite these and other shortcomings.

[0003] Recently, nondegradable composite building materials have been manufactured from post-consumer and post-industrial plastics, such as high-density polyethylene (HDE), and employed in the manufacture of degradation-resistant substitutes for simple wood building forms, such as railroad ties. Examples of these materials and related building forms are described in U.S. Patent Nos. 6,191,228, 5,951,940, 5,916,932, 5,789,477, and 5,298,214. Materials described in these patents possess similar strength as commonly used wood building materials. However, simple building forms, such as railroad ties, produced from such nondegradable materials, have been found to lack the stiffness of their wood counterparts. Moreover, it was not known whether building forms more sophisticated than simple railroad ties, such as beams including one or more flanged sections (e.g., I-beams), could be produced from such materials, prior to the invention described herein.

## BRIEF SUMMARY OF THE INVENTION

[0004] Described herein are novel degradation-resistant building forms formed from a material substantially composed of (and typically consisting essentially of, if not consisting entirely of) a high-density polyolefin and either a thermoplastic-coated fiber material, polystyrene, or a combination thereof. These building forms can further be characterized by the inclusion of one or more flange sections and/or structures that permit the building form

to interlockingly engage other building forms. Also described here are structures comprising or formed from such building forms.

## BRIEF DESCRIPTION OF THE FIGURES

**[0005]** Figure 1 is a photograph providing a side view of an I-beam composed of a degradation-resistant high-density polyethylene fiberglass composite.

**[0006]** Figure 2 is a photograph providing a side view of a series of degradation-resistant I-beams according to the invention.

**[0007]** Figure 3 is a photograph showing a section of a matrix of nested I-beams formed from degradation-resistant materials according to the invention, wherein the I-beams have been fitted with metal couplings.

**[0008]** Figure 4 is a photograph of another section of a matrix of nested I-beams comprising metal couplings for additional support.

**[0009]** Figure 5 is a photograph showing tongue-and-groove panels formed from a degradation-resistant composite comprising high-density polyethylene and fiberglass.

**[0010]** Figure 6 is a photograph of a vehicular bridge assembled from nested I-beams and interlocking tongue-and-groove panels composed of degradation-resistant composites according to the invention.

## DETAILED DESCRIPTION OF THE INVENTION

**[0011]** The inventors have developed a number of new building forms formed from materials that are significantly more resistant to degradation than wood and which comprise a high-density polyolefin and either a thermoplastic-coated fiber material, polystyrene, or a combination thereof. Such degradation-resistant materials are expected to resist degradation for periods of up to 50 years or more in the natural environment. The new building forms developed by the inventors comprise one or more relatively thin sections or structures (as compared to, e.g., the structure of a railroad tie) formed from such material. The inventors have discovered that relatively thin structures, such as flanges, ribs, tongue-and-groove adapted panels, and the like, formed from such materials can surprisingly be used in the support of stable and useful building structures. The inventors also have used such degradation-resistant materials to produce relatively complex building forms (as compared to simple boards), such as I-beams, T-beams, and interlocking beams and panels. The inventors have used such building forms to produce stable load-bearing structures, including (remarkably) vehicular bridges. The inventors also have identified several advantages attendant the use of such new building forms over the use of corresponding wood building forms.

[0012] Useful building forms can comprise any suitable amount of the above-described degradation-resistant material in any suitable configuration. For example, composite building forms comprising one or more thin sections formed from the degradation-resistant material, such as one or more flange sections in a composite T-beam, C-beam, or I-beam, can be useful alternatives to currently available wood building forms. However, such building forms also and preferably can be substantially, if not entirely, formed from such material. Thus, for example, a relatively complex building form, such as an I-beam, can have a composition that is at least about 50%, at least about 75%, at least about 90%, or more, composed of such degradation-resistant material. If other components are mixed with or co-present with the degradation-resistant material, it is preferred that they not interfere with the basic novel and advantageous properties of the material, such as its resistance to degradation, ability to form thin stable structures, low density, and/or strength. Any suitable high-density polyolefin that affords these properties can be incorporated into the degradation-resistant material. Several polyolefins are known in the art. The inventors have determined that high-density polyethylene (HDPE) is particular advantageous in producing the building forms described herein. Where the presence of a thermoplastic-coated fiber material is desired, any suitable fiberglass can be used. The inventors have determined that materials comprising about 80% HDPE and about 20% polystyrene or fiberglass are particularly effective in forming stable complex building forms. Desirably, the components of the degradation-resistant material are selected such that the material has a specific gravity of about one $g/cm^3$. More particular and preferred aspects of the degradation-resistant materials used to produce the building forms of this invention are described elsewhere herein.

[0013] One group of building forms developed by the inventors can be characterized by the inclusion of a web section (or "body section") and at least one flange section that engages an end of the web section. Such building forms include I-beams and T-beams. Desirably, the inventors have produced such structures having strength of about 3,500 PSI and a modulus of at least about 150,000 PSI. Advantageously, building forms produced from such materials typically have a modulus of about 200,000 PSI. Desirably, the form has an area moment of inertia of at least about 900 $in^4$ when measured through the central axis of the form. The ability to produce complex building forms from these materials allows the engineer or user to produce building forms having significantly higher area moment of inertia. For example, large I-beams produced from the above-described degradation-resistant materials (e.g., having an area of about 120 square inches) can have an area moment of inertia of more than about 4500 $in^4$.

[0014] Another group of building forms developed by the inventors can be characterized by the inclusion of a grooved end and a tongue-forming end. The tongue-

forming end is adapted to interlockingly engage a groove having the same shape and dimensions as the grooved end, such that these building forms can be assembled into tongue-and-groove interlocking structures. Such structures are useful in producing flooring for walkways, bridges, and similar structures. As such, these types of building forms will typically comprise a rectangular or square panel shape.

**[0015]** The inventors have also produced other types of interlocking building forms, such as interlocking I-beams, wherein a flange and/or end of a first I-beam is adapted to "nest" in between the flanges of a second I-beam.

**[0016]** The degradation-resistant building forms described herein can form or form part of a collection of building forms, such as may comprise a kit used to build a particular structure. Thus, for example, this invention provides a collection of degradation-resistant building forms comprising a number of interlocking I-beams (e.g., wherein smaller I-beams nest between the flange of larger I-beams), a number of tongue-and-groove interlocking panels, or a combination thereof, wherein at least some of the member building forms of the collection are at least substantially composed of the above-described degradation-resistant material.

**[0017]** Various support structures can be formed from the building forms described herein. Thus, for example, the inventors have produced support stable structures comprising interlocking, nested I-beams formed from a HDPE/fiberglass composite. In such cases, smaller I-beams that nest between the flanges of larger I-beams can serve as joists for the structure. The inventors also have further attached interlocking tongue-and-groove panels to frames produced from such interlocking, nested I-beam structures. For example, the inventors have used such a structure to produce a vehicular bridge.

**[0018]** The material used to produce the inventive building forms advantageously can support metal frames, bolts, and the like, such that it can be readily secured to building materials made of wood, metal, etc. Additionally, metal couplings, frames, and similar structures can be used to provide additional support to interlocking building forms produced from the degradation-resistant materials.

**[0019]** The use of the above-described materials in such complex building forms and structures offers numerous advantages over wood structures, including better resistance to degradation. Particularly advantageous is the fact that the components of such materials are readily available from recycling post-consumer and post-industrial plastic compositions.

**[0020]** For purposes of better illustrating particular aspects of the invention, reference will now be made to the building forms and structures as shown in the figures and specific language will be used to describe the same. It will nevertheless be understood that no

limitation of the scope of the invention is thereby intended, and that the forms and structures shown therein represents only some of the features of the claimed invention.

**[0021]** Figure 1 shows a side view of an I-beam 1 produced from a HDPE/fiberglass composite. The I-beam has a traditional structure consisting of a middle "web" or "body" section 10, an upper flange 30, a lower flange 20. The flange sections include a protruding section 40 that extends beyond the width of the web 10. The face of the web 50 forms a structure that can engage other structures (e.g., smaller I-beams), as described further below. The width **A** of the flange sections is significantly wider than the width **B** of the web section (e.g., about 2 times or more than about 2 times as thick). The height **C** of the flange sections is substantially smaller (e.g., only about 20% of) the height of the web sections. Despite the thinness of the flange section, it is able to support heavy structures and can be used in load-bearing structures, such as bridges and the like.

**[0022]** Figure 2 shows side views of a number of I-beams formed of HDPE/fiberglass composites as described above.

**[0023]** Figures 3 and 4 show a matrix 200 of interlocking, nested I-beams. The ends of smaller, joist I-beams 250 are supported within the openings 50 between the flange sections of the larger, above-described I-beams 10. Metal couplings 100 are secured to the larger and smaller I-beams to provide additional support.

**[0024]** Figure 5 shows tongue-and-groove decking panels 300 produced from a HDPE/fiberglass composite. The panels comprise an end having a tongue shape 320 and an opposite grooved end 310. The flat top of the panels 350 can serve as a surface or barrier when such panels are assembled into a structure.

**[0025]** Figure 6 illustrates a vehicular bridge 400 assembled from the above-described building forms. In the bridge structure, larger I-beam rails 410 are used to support the support I-beams (the top of which 30 is shown). Smaller joist I-beams supported between the support I-beams (not shown) provide a structure above which tongue-and-groove decking is assembled from the above-described paneling (the top of which 350 makes up the surface of the bridge).

**[0026]** All references, including publications, patent applications, and patents, cited herein are hereby incorporated by reference.

**[0027]** Any combination of the above-described elements in all possible variations thereof is encompassed by the invention unless otherwise indicated herein or otherwise clearly contradicted by context.

**[0028]** The use of the terms "a," "an," "the," and similar referents herein and in the following claims are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. The terms "comprising,"

"having," "including," and "containing" are to be construed as open-ended terms (i.e., meaning "including, but not limited to,") unless otherwise noted. Recitation of ranges of values herein are intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated, and each separate value in any such recited ranges is incorporated into the specification as if it were individually recited. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of examples and exemplary language (e.g., "such as") herein is intended merely to better illuminate the invention and should not be construed as a limitation on the scope of the invention unless otherwise indicated. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention.

**[0029]** Preferred embodiments of this invention are described herein, including the best mode known to the inventors for carrying out the invention. Variations of those preferred embodiments may become apparent to those of ordinary skill in the art upon reading the foregoing description. The inventors expect skilled artisans to employ such variations as appropriate, and the inventors intend the invention to be practiced in ways that may vary from those specifically described herein. Accordingly, this invention includes all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law.

WHAT IS CLAIMED IS:

1. A degradation-resistant building form having a strength of at least about 3,500 PSI, a modulus of at least about 150,000 PSI, and comprising (i) a web section and (ii) a flange section that engages an end of the web section, wherein the web and flange sections are formed from a material that consists essentially of (A) a high density polyolefin and (B) a thermoplastic-coated fiber material, polystyrene, or a combination thereof.

2. The degradation-resistant building form of claim 1, wherein the form comprises two flange sections that engage opposite ends of the web section.

3. The degradation-resistant building form of claim 1 or claim 2, wherein the form has an area moment of inertia of at least about 900 $in^4$ when measured through the central axis of the form.

4. The degradation-resistant building form of any one of claims 1-3, wherein the material has a specific gravity of about 1 $g/cm^3$.

5. The degradation-resistant building form of any one of claims 1-4, wherein the high-density polyolefin is high-density polyethylene (HDPE).

6. The degradation-resistant building form of claim 5, wherein the material comprises about 80% HDPE and about 20% polystyrene or fiberglass.

7. A degradation-resistant building form comprising a grooved end and a tongue-forming end composed of a material consisting essentially of (A) a high-density polyolefin and (B) a thermoplastic-coated fiber material, polystyrene, or a combination thereof,

wherein the tongue-forming end is adapted to interlockingly engage a groove having the same shape and dimensions as the grooved end.

8. The degradation-resistant building form of claim 7, wherein the material has a specific gravity of about 1 $g/cm^3$.

9. The degradation-resistant building form of claim 7 or claim 8, wherein the high-density polyolefin is high-density polyethylene (HDPE).

10. The degradation-resistant building form of claim 9, wherein the material comprises about 80% HDPE and about 20% polystyrene or fiberglass.

11. A collection of degradation-resistant building forms composed of a material consisting essentially of (A) a high density polyolefin and (B) a thermoplastic-coated fiber material, polystyrene, or a combination thereof and comprising at least two interlocking I-beams.

12. The collection of degradation-resistant building forms of claim 10, further comprising a number of interlocking tongue-and-groove panels formed from the material.

13. The collection of degradation-resistant building forms of claim 11 or claim 12, wherein the material has a specific gravity of about 1 $g/cm^3$.

14. The collection of degradation-resistant building forms of any one of claims 11-13, wherein the high-density polyolefin is high-density polyethylene (HDPE).

15. The collection of degradation-resistant building forms of claim 14, wherein the material comprises about 80% HDPE and about 20% polystyrene or fiberglass.

16. A support structure formed from a number of interlocking I-beams formed from a material consisting essentially of (A) a high density polyolefin and (B) a thermoplastic-coated fiber material, polystyrene, or a combination thereof.

17. The support structure of claim 16, wherein the high-density polyolefin is high-density polyethylene (HDPE).

18. The support structure of claim 17, wherein the material comprises about 80% HDPE and about 20% polystyrene or fiberglass.

19. The support structure of any one of claims 16-18, wherein the support structure further comprises a number of interlocking tongue-and-groove panels formed from the material that are at least partially attached to at least some of the I-beams.

20. The support structure of claim 19, wherein the support structure is a vehicular bridge.

## ABSTRACT

Degradation-resistant building forms that include a flange and/or are adapted to interlockingly engage similar forms can be made from materials consisting essentially of a high-density polyolefin and either a thermoplastic-coated fiber material, polystyrene, or a combination thereof. Examples of such building forms include I-beams, T-beams, and tongue-and-groove interlocking panels. Useful and stable structures, such as vehicular bridges, can be produced from such building forms.

Attorney Docket No. P26,788

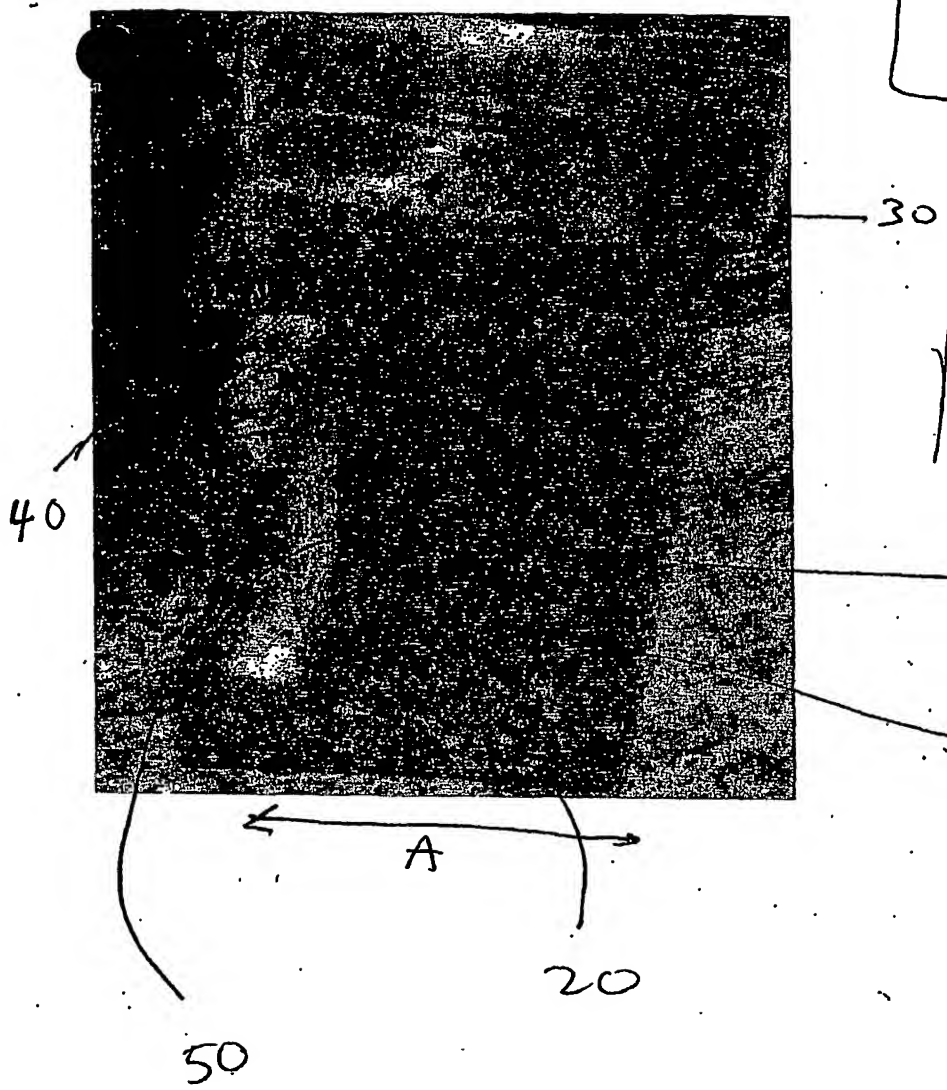


Figure 1

Filed July 8, 2003


Fig. 2

Atty Docket No. P26,788

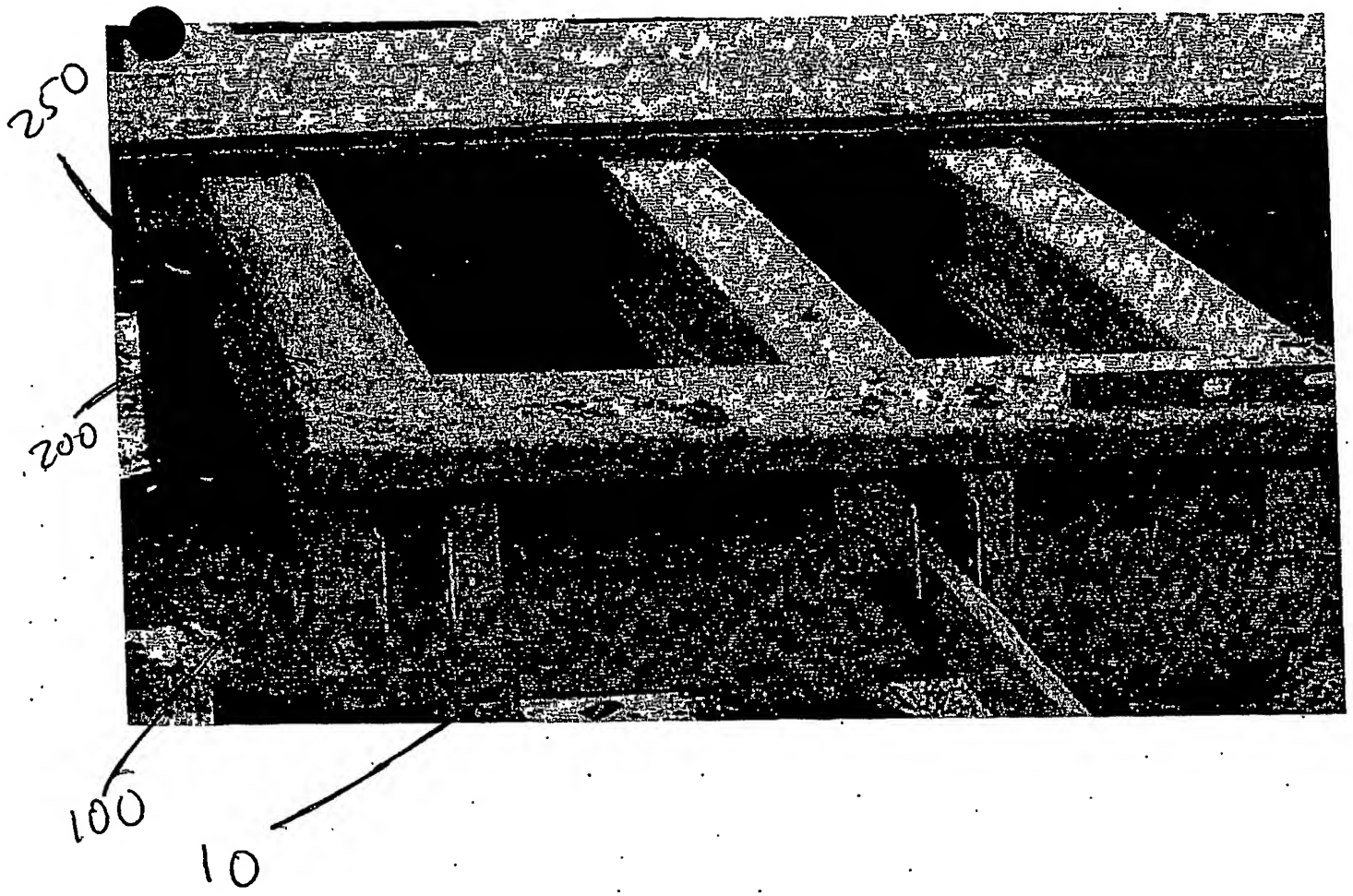


Fig. 3

Atty Docket No.
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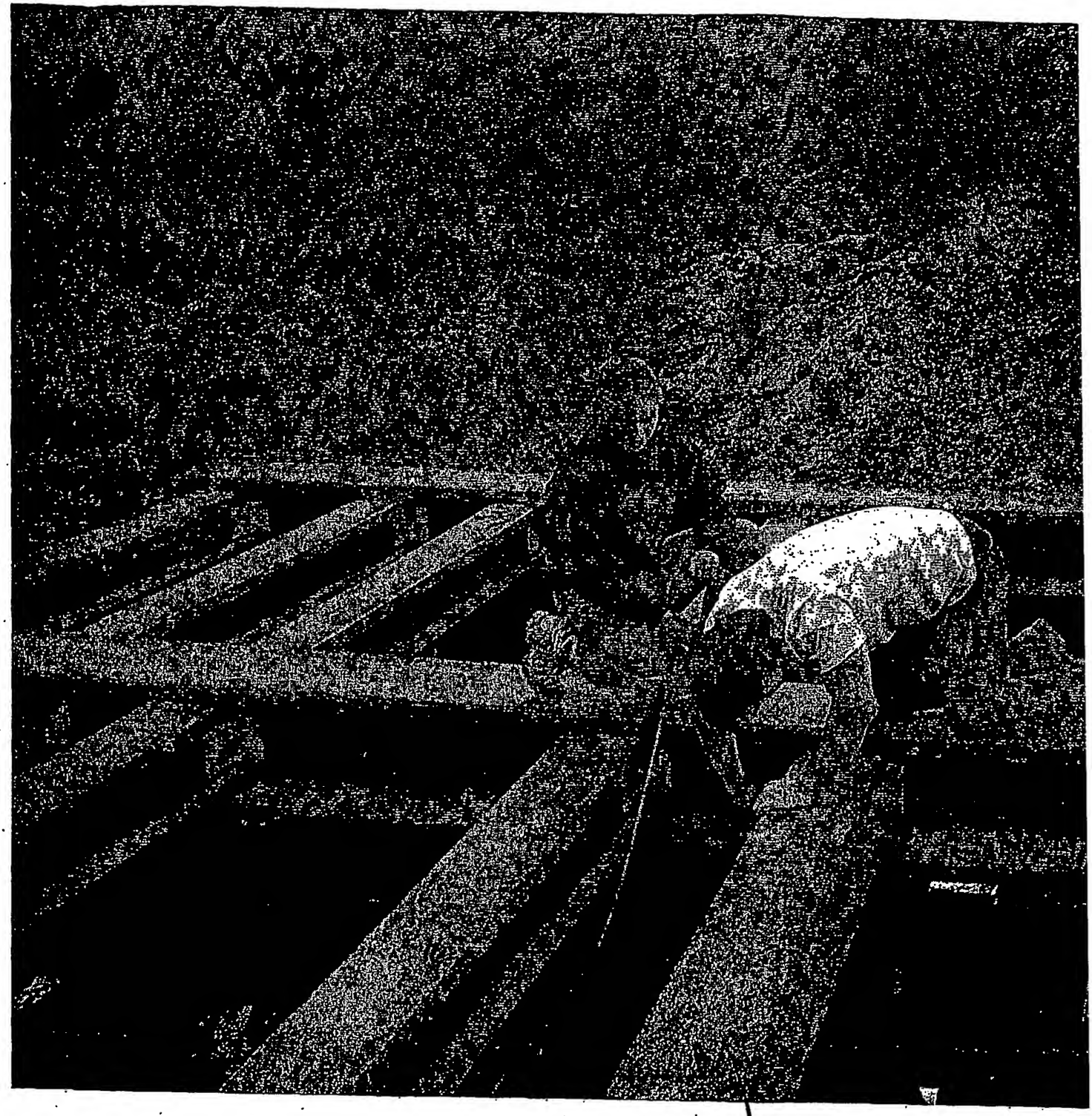


Fig. 4

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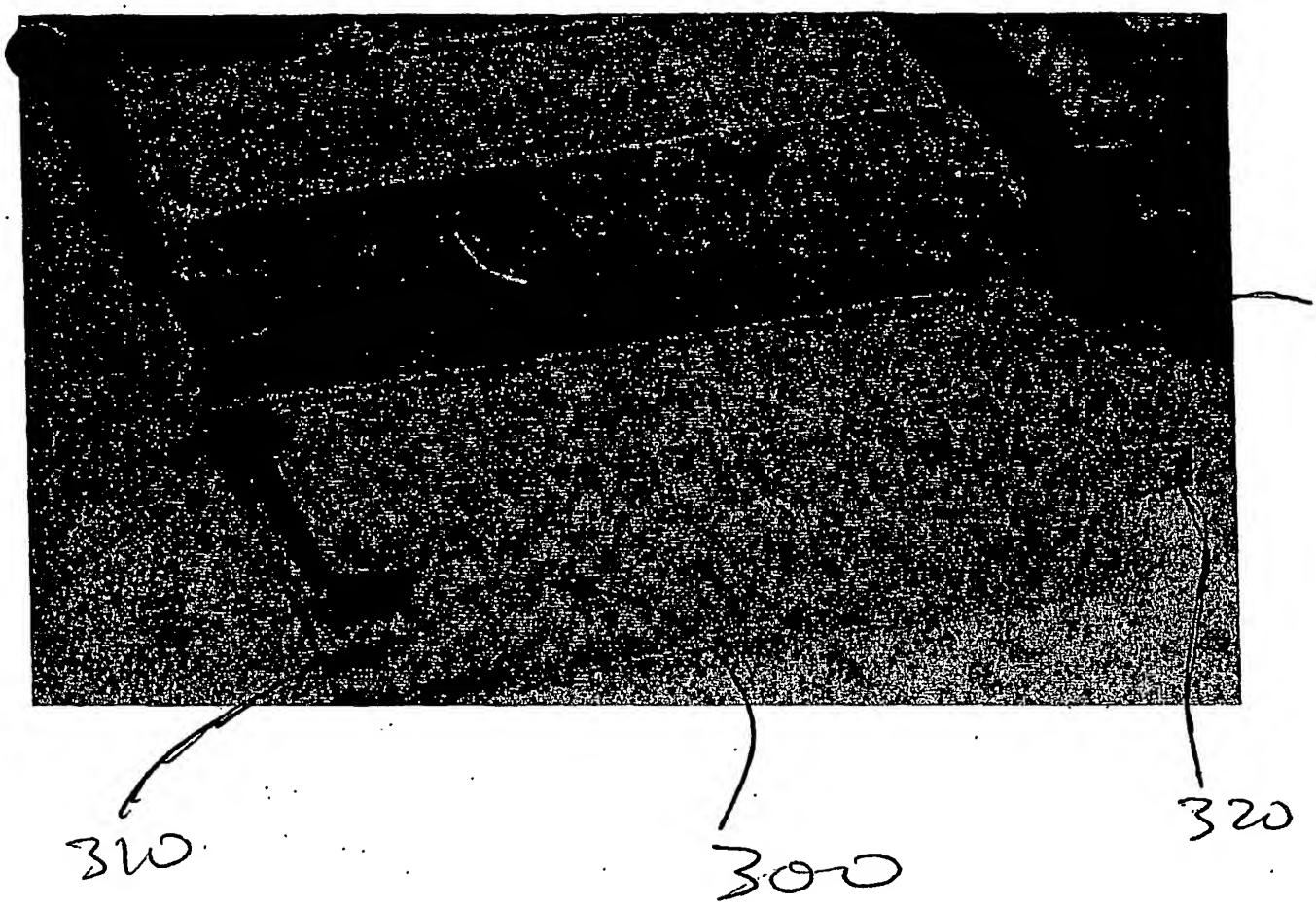


Fig. 5

Atty Docket No.
P 26, 788

Fig 6 Atty Docket No P 20,788